

# Notice of Allowability

Application No.

09/733,254

Examiner

Tuan A Vu

Applicant(s)

GRANSTON ET AL.

Art Unit

2124

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 10/18/2004.
2. ☒ The allowed claim(s) is/are 1-4.
3. ☒ The drawings filed on 08 December 2000 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☐ All b) ☐ Some\* c) ☐ None of the:
    1. ☐ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
  6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
    - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
    - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

- |   |   |
|---|---|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)  | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)           |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                | 6. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date _____ |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),<br>Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment                   |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material          | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance  |
|   | 9. <input type="checkbox"/> Other _____   |

### DETAILED ACTION

1. This action is responsive to the Applicant's response filed 10/18/2004.

As indicated in Applicant's previous amendment, claims 5-6 have been amended. Claims 1-4 are pending in the office action.

### EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Robert Troike, Reg # 24183 on 12/20/04.

The application has been amended as follows:

#### As per claim 1:

A method of pipelining program loops having irregular loop control comprises the steps of:

determining which instructions in loop code in a memory may be speculatively executed ~~without special hardware support or special loop control instructions~~, if it is determined that the instruction would be able to be speculatively executed except that it modifies a register that is alive out of the loop performing the steps of:

storing in a computer memory a set of registers that are modified by an said instruction and are alive out of the loop, and

modifying the program code so that the values of those registers are saved to a temporary register during all proper iterations, and

copying back to the said registers the values of the temporary register once the loop is completed.

***EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE***

3. The Appeal Brief filed 10/18/2004 has been considered; and as a result, claims 1-4 are allowed.

The following is an examiner's statement of reasons for allowance.

The prior art of record, taken alone or in combination fails to teach or suggest the following claimed features:

A method for software pipelining of irregular control loops, comprising (i) determining or pre-processing if a loop code instruction can be speculatively executed; and if it is determined that it can be speculatively executed except that it modifies a register that is alive out of the loop; (ii) performing register copying as recited in claim 2; or (iii) storing a set of registers that are modified by said instruction and are alive out of the loop; (iv) modifying the program code so that the values of those registers are saved to a temporary register and copying back the values of said temporary register to those registers once the loop is completed as recited in claim 1.

**Rau\_1**, "Code Generation Schema for Modulo Scheduled Loops", discloses rotating registers in applying predicative or speculative execution of loops with special hardware support but does not explicitly teach determining if a instruction can be speculatively executed except that it modifies a register alive out of the loop; nor does Rau\_1 teach using a temporary register

Art Unit: 2124

to store values of registers that are determined to be modified by said instruction as in (i), (ii) or (iii) and (iv).

**Rau\_2**, "Register Allocation for Software Pipelined Loops", teaches live-in, live-out registers and invariant in loops variables but only applies this in the context of extending the life of those variables needed outside the loop; does not apply the live-in live-out registers for speculatively execution of instructions; hence fails to teach or suggest the determining as in (i), and the register copying as (ii) or temporary register as in (iii) and (iv)

**Akkary**, USPN: 6,240,509, discloses use of temporary registers for recovery from mishaps incurred in wrong paths taken by speculative execution but does not teach determining of instruction that would modify registers live of out the loop for safe speculative execution; and determining a set of registers alive being susceptible to be modified by such instruction for register copying or temporary values storage as in (i)-(iv) from above; because Akkary's recovery from mis-speculated execution is not the same as determining ahead how some instruction can be safely speculated if it can potentially modify a register live out when the loop is completed; and take measures based thereupon.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Conclusion***

Art Unit: 2124

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan A Vu whose telephone number is (272) 272-3735. The examiner can normally be reached on 8AM-4:30PM/Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kakali Chaki can be reached on (571)272-3719.

The fax phone number for the organization where this application or proceeding is assigned is (571) 273-3735 ( for non-official correspondence – please consult Examiner before using) or 703-872-9306 ( for official correspondence) or redirected to customer service at 571-272-3609.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

VAT  
December 20, 2004

*Kakali Chaki*

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